DES Keyloader and Interface Cables

Option V4025

M/A-COM Wireless Systems
3315 Old Forest Road
Lynchburg, Virginia 24501
(Outside USA, 434-385-2400) Toll Free 800-528-7711
www.macom-wireless.com

Printed in U.S.A.

TABLE OF CONTENTS

SPECIFICATIONS**

Power Requirement	6 Vdc (four "AA" size batteries)
Output Connector	8-circuit modular (telephone type RJ-31)
Operating Temperature Range	-20°C to +50°C
Size	5.6" x 3.2" x 1.6"
Weight	0.8 lbs.
Battery Life	50 hours (alkaline batteries) 100 hours (mercury batteries)*
Power-Down	Automatically shuts-off 60 seconds after last keypad activity
Humidity, Shock & Vibration	Per EIA RS-316-C
Keypad	25-button, flexible rubber

*low temperature limited to 0°

**These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

DESCRIPTION

The DES (Data Encryption Standard) Keyloader 19A148910P1 (Option V4025) is a small handheld calculator-type unit used to load cryptographic keys into Voice Guard® and Aegis encrypt/decrypt equipment. This unit has a 25-button keypad and a 16-digit alphanumeric liquid crystal display (LCD). DES cryptographic keys are directly entered into and stored in the Keyloader. The keys are then transferred into a portable or mobile radio, or station equipment using the Keyloader and the associated interconnecting cable. The cryptographic protection of this system is based on a proprietary DES algorithm employing non-linear data spreading and iterative key scheduling.

The Keyloader includes two (2) interconnect cables used to transfer the cryptographic keys into the encrypt/decrypt equipment. Cable 19A148910P2 is used to transfer keys into Voice Guard equipment associated with stations, controllers, mobiles and MPS portable radios. Cable 19A148910P6 is used to transfer keys into the M-PD portable radios.

The cryptographic key is sixty-four (64) bit parameter consisting of 56 independent bits and 8 parity bits, which is defined by sixteen (16) hexadecimal digits. The 56 independent bits permit 2^{56} or 7.2 times 10^{16} possible key combinations. The key controls the encryption of messages at the transmitter and the corresponding decryption of these messages at the receiver. When transmitting, digitized plain text and the cryptographic key are processed by the encryption device to generate cipher text. The process is reversed when receiving. Before messages can be encrypted and decrypted successfully, identical keys must be loaded into the encrypt/decrypt equipment at both the transmitting and receiving locations.

Because it is the only unknown parameter of the system, the cryptographic security of the entire system depends on the secrecy of the cryptographic key(s). Therefore, key management and electrical and mechanical integrity of the Keyloader are of great importance.

CRYPTOGRAPHIC KEY STORAGE AND TRANSFER TECHNIQUES

The Keyloader stores up to seven keys (1 group of 7 keys) or optionally up to 56 keys (8 groups with 7 keys in each group). Each key consists of eight pairs of two hexadecimal digits displayed as two sequences of eight digits.

It is recommended that cryptographic keys not start with digit pair "00". While the use of "00" as the first pair in a DES key presents no operational cryptographic comprise, it could result in a spurious indication of the Keyloader of no key being stored when actually there was one stored.

When a key is transferred from the Keyloader into the encrypt/decrypt unit, a key position number (1 - 7) is also transferred. This key position number gives multi-key encrypt/decrypt units the ability to store up to seven (7) keys in a position selected from the Keyloader. A Keyloader configured in this manner will display "OPTION 1" at power-up.

An additional Keyloader option can be set to force the Keyloader to strip-off the key position number (1 - 7) that is transferred along with the key. With this option enabled, keys will always be stored in key position one (1) of multi-key encrypt/decrypt units. A Keyloader configured in this manner will display "OPTION 2" at power-up and keys will always be transferred into key position number one (1) of the encrypt/decrypt unit. This option is supported by Keyloader firmware version 1.1 and higher.

See the OPTIONAL CONFIGURATIONS section of this manual for details on configuring the Keyloader for 7 or 56-key storage, and "OPTION 1" or "OPTION 2".

7-Key Storage

When transferring a key into a multi-key encrypt/decrypt unit with a Keyloader configured for 7-key storage (standard) and OPTION 1, the key will be stored in the encrypt/decrypt unit's cryptographic key memory position that corresponds to the key position number. For example, the key in position 5 of the Keyloader will be transferred into key position 5 of the multi-key unit and any previous key stored in the key position 5 will be overwritten.

With the Keyloader configured for 7-key storage (standard) and OPTION 2, the key will be stored in the encrypt/decrypt unit's cryptographic key memory position one (1) when it is transferred into a multi-key encrypt/decrypt unit. For example, the key in position 5 of the Keyloader will be transferred into key position 1 of the multi-key unit and any previous key stored in the key position 1 will be overwritten.

Transferring a key into a single-key encrypt/decrypt unit will overwrite any previous key stored in the unit.

56-Key Storage Option

With the 56-key storage option enabled, eight (8) groups with seven (7) keys in each group can be stored in the Keyloader. The 56-key storage map is shown in Figure 1. Key 1.1 has position number 1 and key 2.6 has position number 6.

If the Keyloader is configured for 56-key storage and "OPTION 1", and a key is transferred to a multi-key encrypt/decrypt unit such as an M-PA or M-PD portable, the key will be stored in the unit's cryptographic key memory position that corresponds to the key position number. The key group number is not transferred to the unit. For example, key 1.5 and 6.5 will both be transferred into the multi-key encrypt/decrypt unit's position 5 and the last key transferred will be the active key 5 (the previous key will be overwritten).

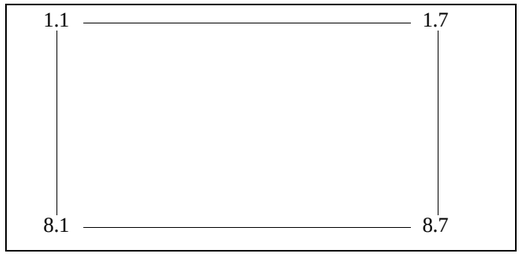


Figure 1 - 56-Key Position Map

CIRCUIT ANALYSIS

The Keyloader is a microprocessor-based, battery-operated, handheld unit used to enter, store, and transfer DES cryptographic keys to DES communications equipment. The use of CMOS integrated circuit technology provides low-current drain and thus long battery life. Three (3) printed circuit boards in the Keyloader contain the electronic circuitry.

DISPLAY BOARD

The display board contains an Intel 80C31 CPU (central processing unit) for the Keyloader. This IC, U7, executes the operating program stored in the 27C64 EPROM U5. Integrated circuit U6 is a 74C373 octal (8-bit) latch that provides multiplexing for the address and data busses. The address on U7's bus is clocked into U6 on the falling edge of the ALE pulse from U7.

Microprocessor U7 communicates with a microcontroller in LCD module U3. The LCD module is a Densitron LM70A2C8CBH which accepts ASCII inputs on the 8-bit data bus from the 80C31. Three control lines, RS, R/W and E, from the 80C31 are used for display control. The extended temperature range LCD requires -5 Vdc and +5 Vdc supplies. The -5 Vdc power is generated on the keypad board and applied to U3 via P1 pin 9.

Cryptographic keys entered into the Keyloader are stored in RAM U4. This IC is a 2K x 8-bit CMOS static RAM type 6116. This RAM is the only component continually powered by unswitched battery power. This allows continual storage of the DES keys during Keyloader power-off.

The microprocessor detects low battery voltage by reading the logic level on U8 pin 11. U8 is wired as an inverting buffer and it is fed by the collector of Q5. Transistor Q5 pulls high as long as the battery voltage is greater than 4.1 Volts. The detection voltage is determined by the resistance ratio of R17 to R18.

INTERFACE BOARD

The interface board contains circuitry used to communicate with the mating DES communications equipment. Integrated circuit U9 is an open-drain hex buffer 74C906. RC networks are added to the output lines on P3 pins 1, 3 and 4 to slow the rise and fall times of the pulses in the interconnecting cable. This is necessary to eliminate crosstalk in the coil cord. These components are R23, R24, R30, C8, C9, and C10. The diodes on these output lines and the input line on P3 pin 2 provide static protection.

Integrated circuit U10 is a 4528 CMOS IC used to provide watchdog timing and power-up reset for the microprocessor on the display board. When the Keyloader is turned on a power-up reset signal for the microprocessor is generated at U9 pin 11 and applied to the watchdog circuit. Zener diode D15 pulls buffer U9 pin 10 high when the supply rises to approximately 4 Volts. The power-up reset pulse is then applied to the microprocessor via Q6 and J2 pin 9. After the microprocessor is reset, it must pulse J2 pin 5 periodically to prevent the watchdog timing circuit from resetting it.

KEYPAD BOARD

The keypad board has traces which serve as switch contacts for the keypad switch matrix. The keypad is constructed of a silicon rubber material with conductive contacts that touch the associated trace on the board when an individual button on the keypad is pressed. A tactile-feel is provided to indicate contact to the traces on the keypad board. The silicon rubber keypad construction seals the internal circuitry from outside contamination such as dust, dirt and moisture.

The switch traces are connected to U1 which is an 82C43 input/output expander used to scan the keypad switch matrix. This IC is controlled by the microprocessor via the ACK, REQ, PROG, P20, P21, P22, and P23 control lines.

The power switch circuit consisting of transistors Q1 and Q2 is located on the keypad board. When the power switch (PWR) is depressed, Q1 turns on. This pulls the base of Q2 low, turning it on to provide battery power (BATT. PWR) from J1 pin 8 to LM2950 regulator U11. Regulator U11 outputs +5.0 Vdc for the keypad board and the other two boards via J1 pins 11 and 12. Before the power switch is released, microprocessor U7 loads U1 on the keypad board with data to pull U1 pin 23 high to keep the transistors (and thus the Keyloader) on.

Integrated circuit U2 is a 7660 dc-to-dc converter IC that generates a -5 Vdc supply for the LCD module on the display board. U2 and associated components convert the +5 Vdc power to -5 Vdc power.

OPTIONAL CONFIGURATIONS

Two (2) jumpers on the keypad board are used to configure the Keyloader for the optional configurations explained in the DESCRIPTION section of this manual.

The GROUP JUMPER at U1 pin 14 is normally supplied in place. With the jumper in place, U1 pin 14 is low and the Keyloader is configured for one group of seven keys. These keys are identified 1.1 through 1.7. With the GROUP JUMPER cut, U1 pin 14 is high and eight group capability (56- keys storage) is enabled.

The OPTION JUMPER is utilized only with DES Keyloader firmware version 1.1 and above. With this jumper in place, U1 pin 16 will be low. At power-on, the Keyloader will display "OPTION 1". The Keyloader will then transfer the key and its position number. With the OPTION JUMPER cut, U1 pin 16 will be high and the unit will display "OPTION 2" at power-on. With this configuration, each key that is transferred will have the position number "1".

OPERATION

Refer to LBI-31685 for completed operating details on the DES Keyloader.

Cryptographic keys are entered and stored in the Keyloader one digit at a time using the keypad. The keys can then be selected for transfer to DES Voice Guard or Aegis encrypt/decrypt equipment through the interconnect cable. Keys cannot be re-displayed once they are stored in memory of the Keyloader.

The Keyloader can be placed in either of two (2) operating modes, MASTER or SLAVE. In the MASTER MODE all operating functions can be performed. The SLAVE MODE disables all operating functions except the key transfer function. This feature permits one person (e.g., security officer) to program the keys, and another person to transfer the keys without being able to alter or recall any key.

All cryptographic keys and passwords stored in the Keyloader will be erased if the batteries are removed from the unit. The keys and passwords must then be reentered when power is restored to the Keyloader. Default codes loaded into memory upon restoring power are shown is Table 1.

TABLE 1 - DEFAULT CODES

MODE	HEX CODE
MASTER	0000
SLAVE	0000
TEST	FFFF

MAINTENANCE

BATTERY REPLACEMENT

1. Remove the four (4) Phillips screws securing the back cover and remove the cover.
2. Replace the four (4) AA batteries in the battery pack, observing battery polarity.
3. Reinstall rear cover and tighten four (4) Phillips screws.

NOTE

The memory in the Keyloader may be erased when the batteries are replaced. Upon power-up, the default codes are loaded into memory and the display will show "MEMORY ERASED". If this occurs, press the EXE key to get into the MASTER MODE.

TEST PROCEDURES

If the Keyloader does not operate when the power button (PWR) is pressed, proceed as follows:

1. Check the batteries and the associated contacts.
2. Verify +5 Vdc power from regulator U11 on the keypad board is being supplied to all of the ICs in the Keyloader. If U11's output is not 5 Vdc, check power switch circuit Q1 and Q2 for proper operation. If the Keyloader will only operate with the PWR button depressed, suspect U1 on the keypad board.
3. Monitor U7 pin 19 for 3.58 MHz 4-Volt peak-to-peak pulses. If none are present suspect U7 or crystal X1.
4. Check the ALE pulses from U7 pin 30. At this point, 4-Volt peak-to-peak pulses should be here at approximately 300 kHz.
5. Check the microprocessor reset input at U7 pin 9. It should be low. If it is high, troubleshoot the 5V level sense and watchdog circuits made up of D15, U9 (pins 10 and 11) and U10 respectively.
6. Once the Keyloader comes up, log-on in the Test Mode and conduct tests O through E. Tests 4 through C and test E require the construction of a tester as shown in Figure 2. See Table 2 in this manual, and the Operator's Manual for further details.

TABLE 2 - TEST MODE DEFINITIONS

TEST	FUNCTION	ACTION IF TEST FAILS
0	Illuminate all pixels	Check IC 1 and IC 3
1	Echo depressed keys	Check IC 1
2	RAM test (non-destructive)	Check BATT PWR to IC 4
3	Watchdog timer test (resets unit)	Check IC 10
4	Set ACK line high	Check U9 on interface board
5	Set ACK line low	Check U9 on interface board
6	Set CLK line high	Check U9 on interface board
7	Set CLK line low	Check U9 on interface board
8	Set DATA line high	Check U9 on interface board
9	Set DATA line low	Check U9 on interface board
A	Read REQ line and display state	Check U9 on interface board
B	Read Data line and display state	Check U9 on interface board
C	Turn Keyloader off	Check U1, Q1 and Q2 on key board
D	Verify EPROM checksum	Return Keyloader for factory service
E	Generate 9600 baud pulses on CLK for 30 seconds	Check U9 on interface board
F	Unassigned	N/A

ERROR CODES

A series of handshakes and tests are performed between the Keyloader and the DES unit before the actual transfer of the cryptographic key(s). A failure to any of these tests causes the Keyloader to display an error message and terminate the data transfer sequence. Table 3 lists the error codes.

TABLE 3 - ERROR CODES

MESSAGE	MEANING	CAUSE
"ERROR 1"	Time-out during 8-box test	Cable not connected-VG unit not in fill-wrong algorithm
"ERROR 2"	External S-Box test failure	VG DES chip defective
"ERROR 3"	Parity test failure	VG DES chip defective
"ERROR 4"	Test key failure	VG unit defective
"ERROR 5"	Time-out during auto-test	VG unit failure
"ERROR 6"	Auto-test test failure	VG unit failure
"ERROR 7"	Auto-test status byte error	VG unit failure
"ERROR A"	Time-out during key transfer	VG unit failure

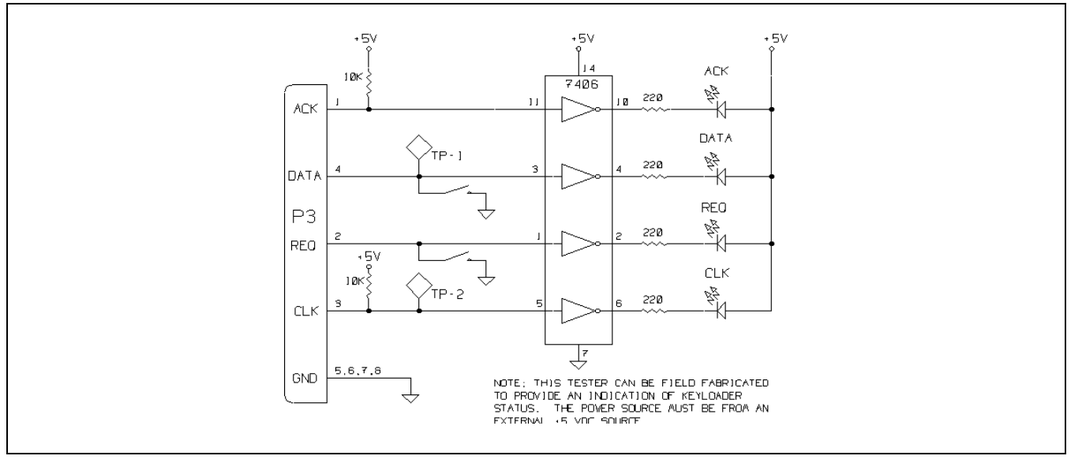


Figure 2 - Schematic Diagram Of The Keyloader Tester

OPTIONS AND ACCESSORIES

INTERFACE CABLES

Each Keyloader is supplied with two (2) interface cables to transfer cryptographic keys from the Keyloader into the encrypt/decrypt equipment. Cable 19A148910P2 (Option V4027) is used to connect the Keyloader to encrypt/decrypt equipment associated with stations, controllers, mobiles and MPS portable radios. Cable 19A148910P6 (Option V4029) is used to connect the Keyloader to M-PD portable radios equipped for encrypt/decrypt operation. Both cables are coiled-cord type, approximately 12 inches long and extendable to 36 inches. Cable 19A148910P2 has each end terminated with an 8-circuit telephone-type modular connector. Cable 19A148910P6 has one end terminated the an 8-circuit modular connector (plugs to Keyloader) and the other end terminated with a Universal Device Connector (UDC) to allow connection to the M-PD radios. Table 4 lists the wiring for the cables.

TABLE 4 - CABLE WIRING

FUNCTION	PIN
ACK	1
REQ	2
CLK	3
DATA	4
GROUND	5-8

CARRYING CASE

Nylon carrying case 19C336690P1 (Option V4026) is available to provide protection and storage for the Keyloader, Interconnect Cable and the Operator's Manual.

WARRANTY SERVICE

All warranties must be performed at IDA Corporation. No credit will be given for unauthorized repair work attempted by the customer. In-warranty merchandise must be shipped freight prepaid to IDA Corporation. IDA will repair or replace equipment and return to customer, freight prepaid, within the continental United States. Equipment found not to be defective will be returned at purchaser's expense and will include cost of handling, testing and returning of equipment.

Equipment returned for repair must have a return merchandise authorization number (RMA). Please contact IDA Corporation for an RMA number prior to shipment. Ship all warranty units to 1100 32nd Avenue South, Moorhead, MN 56560.

Out-of-warranty repairs will be billed at the established factory flat-rate per hour, plus components needed for replacement.

DES KEYLOADER OPTION V4025
19A148910P1
ISSUE 1

SYMBOL	PART NUMBER	DESCRIPTION
		—— MECHANICAL PARTS ——
1	J19/260-0021	Cord: Coil.
2	J19/900-5024	Brackets: Metal Case. (Qty of 4).
3	J19/900-0510	Case: Top.
4	J19/900-0509	Case: Bottom.
5	J19/900-0507	Bezel: Plastic Keypad.
7	J19/199-3066	Screw, countersunk: 4-40 x 1/4". (Qty of 8).
8	J19/199-0352	Nut: S-440-1. (Qty of 8).
9	J19/199-6007	Plate: Serial Number.
10	J19/203-1203	Window: Clear Plastic.
		———— CABLES ————
	19A148910P2	Cord: OPTION V4027. Both ends terminated with an 8-circuit telephone type modular connector. (For stations, controllers mobiles and MPS portables).
	19A148910P6	Cord: OPTION V4029. One end terminated with an 8-circuit telephone type modular connector, one end terminated with UDC. (For M-PA and M-PD portables).

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

KEYLOADER KEYPAD BOARD
J19/101-0147, Rev. B
ISSUE 3

SYMBOL	PART NUMBER	DESCRIPTION
		———— CAPACITORS ————
C1 and C2	J19/390-0010	Tantalum: 10 µF, 16V.
C3	J19/390-0003	Tantalum: 1 µF, 35 V.
		———— DIODES ————
D1	J19/110-0001	Silicon: 1N914.
		———— JACKS ————
J1	J19/231-3107	Connector: 7-Circuits. (Requires 2).
		———— TRANSISTORS ———
Q1	J19/180-0009	Silicon, NPN: MPS-8098.
Q2	J19/180-0006	Silicon, PNP: 2N5401.
		———— RESISTORS ————
R1	J19/316-0005	Network, 9-element: 4.7K ohms.
R2 and R3	J19/312-0011	10K ohms ±5%, 1/4 w.
R4	J19/312-0019	1K ohms ±5%, 1/4 w.
R5 thru R7	J19/312-0011	10K ohms ±5%, 1/4 w.
R31	J19/312-0020	47K ohms ±5%, 1/4 w.
		—— INTEGRATED CIRCUITS ——
U1	J19/130-0198	Digital: I/O Expander; 82C43.
U2	J19/130-0216	Linear: DC-to-DC Converter; 7660.
U11	J19/130-0220	Linear: +5-Volt Regulator; LM2950.
		——— MISCELLANEOUS ———
	J19/203-0016	Keypad, 25-Button.

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

KEYLOADER OPTION V4025
J19/101-0148, Rev. B
ISSUE 3

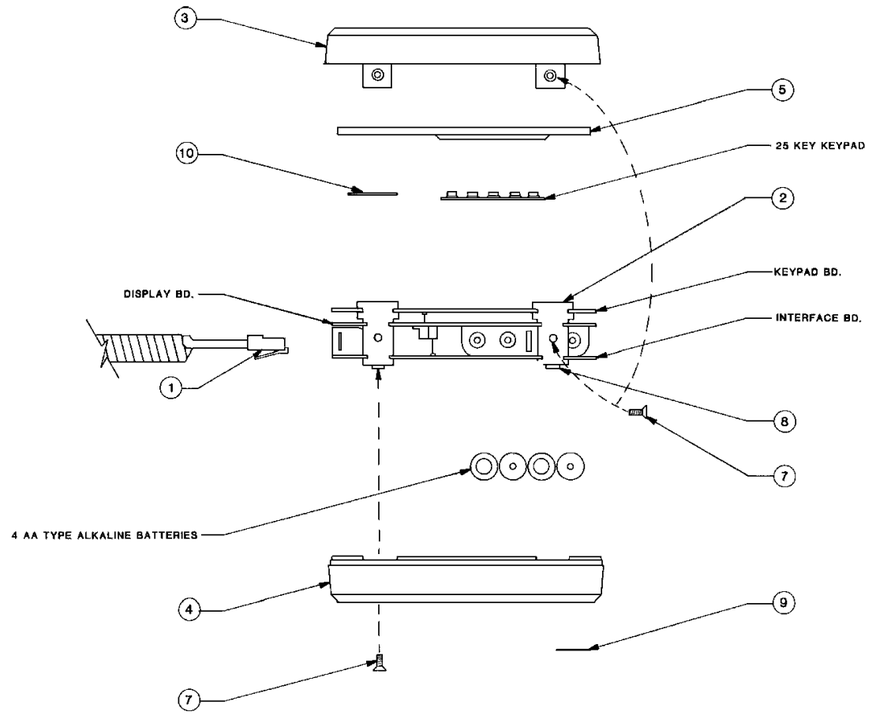
SYMBOL	PART NUMBER	DESCRIPTION
		———— BATTERIES————
B1	J19/399-0003	Alkaline, Size AA.
		———— CAPACITORS ———
C4 and C5	J19/390-0010	Tantalum: 10 µF, 16 V.
C6 and C7	J19/370-0019	Ceramic, disc: 18 pF.
		———— DIODES ————
D1	J19/11O-0008	Diode: 1N6263
		———— PLUGS ————
P1	J19/231-3007	Receptacle: 7-Circuits. (Requires 2).
P2	J19/231-3011	Receptacle: 11-Circuits.
		——— TRANSISTORS ———
Q3 and Q4	J19/180-0009	Silicon, NPN: MPS-8098.
Q5	J19/180-0006	Silicon, PNP: 2N5401.
		———— RESISTORS————
R8	J19/318-0010	Temperature Compensating.
R9	J19/312-0023	3K ohms ±5%, 1/4 w.
R10	J19/312-0055	75K ohms ±5%, 1/4 w.
R11	J19/312-0011	10K ohms ±5%, 1/4 w.
R12	J19/312-0019	1K ohms ±5%, 1/4 w.
R13 and R14	J19/312-0011	10K ohms ±5%, 1/4 w.
R15	J19/312-0003	100K ohms ±5%, 1/4 w.
R16	J19/316-0001	Network, 9-element: 47K ohms.
R17	J19/312-0002	5.6K ohms ±5%, 1/4 w.
R18	J19/312-0014	33K ohms ±5%, 1/4 w.
R19	J19/312-0011	10K ohms ±5%, 1/4 w.
		—— INTEGRATED CIRCUITS ——
U3	J19/113-0100	Liquid Crystal Display; LM70A2C8CBH.
U4	J19/130-0169	Digital: 2K x 8-Bit SRAM; 6116.
U5	J19/130-0217	Digital: 8K x 8-Bit EPROM; 27C64.
U6	J19/130-0218	Digital: Octal Latch; 74HC373.
U7	J19/130-0219	Digital: Microprocessor; 80C31.
U8	J19/130-0074	Digital: Quad AND Gate; 74C08.
		———— CRYSTALS ————
X1	J19/305-0011	3.58 MHz.
		——— MISCELLANEOUS ——
	J19/399-0004	Battery Pack, 4-Position, Size AA.
	J19/199-1002	Screw, Latch: 20-11.
	J19/233-0010	Connector: LM70 20-Circuit. (Used with LCD).

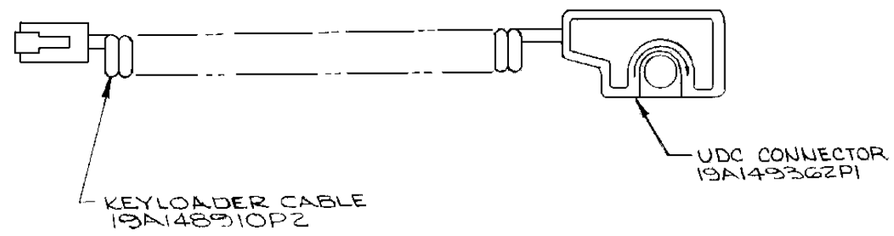
* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

KEYLOADER OPTION V4025
J19/101-0149, Rev. C
ISSUE 3

SYMBOL	PART NUMBER	DESCRIPTION
		———— CAPACITORS ————
C8 thru C10	J19/362-0004	Monolithic: 330 pF.
C11 and C12	J19/390-0004	Tantalum: 4.7 µF, 35 V.
		———— DIODES ————
D3	J19/110-0008	Diode, HCD.
D4	J19/110-0001	Silicon: 1N914.
D5	J19/110-0008	Diode, HCD.
D6	J19/110-0001	Silicon: 1N914.
D7	J19/110-0008	Diode, HCD.
D8	J19/110-0001	Silicon: 1N914.
D9	J19/110-0008	Diode, HCD.
D10 thru D14	J19/110-0001	Silicon: 1N914.
D15	J19/111-0008	Zener: 3.6 V.
		———— JACKS ————
J2	J19/231-3111	Connector: 11-Circuits.
		———— PLUGS ————
P3	J19/231-0020	Receptacle: 8-Circuits.
		———— TRANSISTORS————
Q6	J19/180-0009	Silicon, NPN: MPS-8098.
		———— RESISTORS ————
R21 and R22	J19/312-0011	10K ohms ±5%, 1/4 w.
R23 and R24	J19/312-0044	390 ohms ±5%, 1/4 w.
R25	J19/312-0008	120K ohms ±5%, 1/4 w.
R26	J19/312-0057	180K ohms ±5%, 1/4 w.
R27 thru R29	J19/312-0011	10K ohms ±5%, 1/4 w.
R30	J19/312-0044	390 ohms ±5%, 1/4 w.
R32 and R33	J19/312-0011	10K ohms ±5%, 1/4 w.
		—— INTEGRATED CIRCUITS ——
U9	J19/130-0207	Digital: Hex Buffer, Open Drain; 74C906.
U10	J19/130-0066	Digital: Dual Monostable Multi.; 4528.

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES





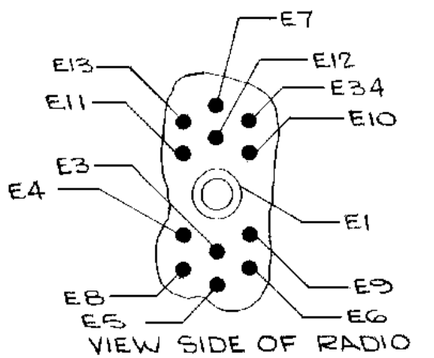
KEYLOADER CABINET ASEMBLY

ITEM	PART NO.	DESCRIPTION	QTY.
1	260-0021	8 CONDUCTOR COIL CORD	1
2	900-5024	METAL CASE BRACKETS	4
3	900-0510	PLASTIC CASE TOP	1
4	900-0509	PLASTIC CASE BOTTOM	1
5	900-0507	PLASTIC KEYPAD BEZEL	1
7	199-3066	4-40 x 1/4 CSNK PH SCW	8
8	199-0352	PEM NUTS S-440-1	8
9	199-6007	DES STNO SER NO PLATE	1
10	203-1203	CLR PLASTIC DSPLY WNDW	1

KEYLOADER
19A148910P4

(4143-S-00, Rev. B)

(19B234966, Sh. 1, Rev. 2)



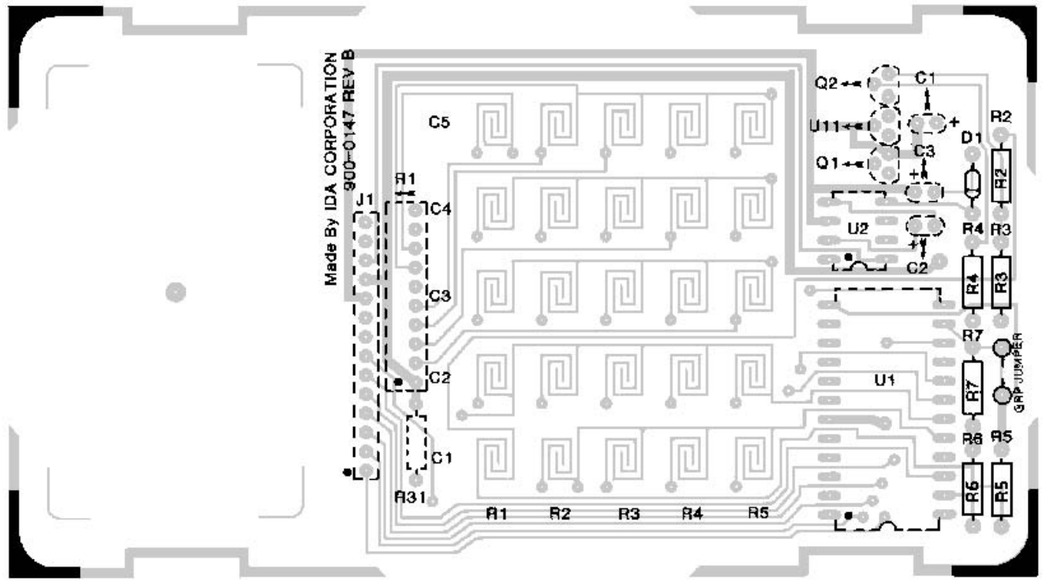
CONTINUITY CHECK	
FROM	TO
PIN 1	E6
PIN2	E7
PIN 3	E5
PIN 4	E13
PIN 5	OPEN
PIN 6	E1
PIN 7	E1
PIN 8	E1

CONNECTIONS CHART		
FROM KEYFILL CONNECTOR		TO UDC. PWB.
PIN 1		H5
PIN 2		H6
PIN 3		H4
PIN 4		H12
PIN 5		CUT OFF
PIN 6		GROUND
PIN 7		GROUND
PIN 8		GROUND

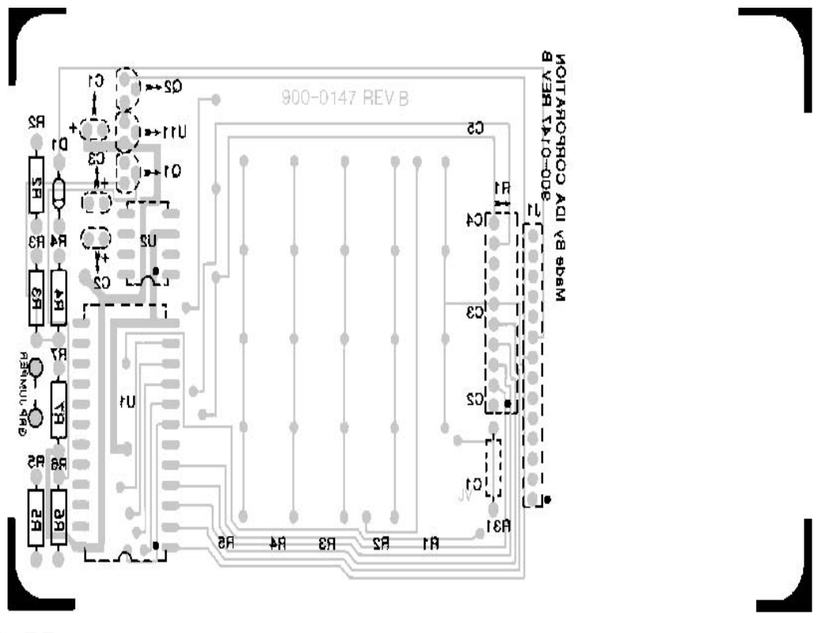
19A148910P2, P6

(19B234966, Sh. 2, Rev. 2)

COMPONENT SIDE



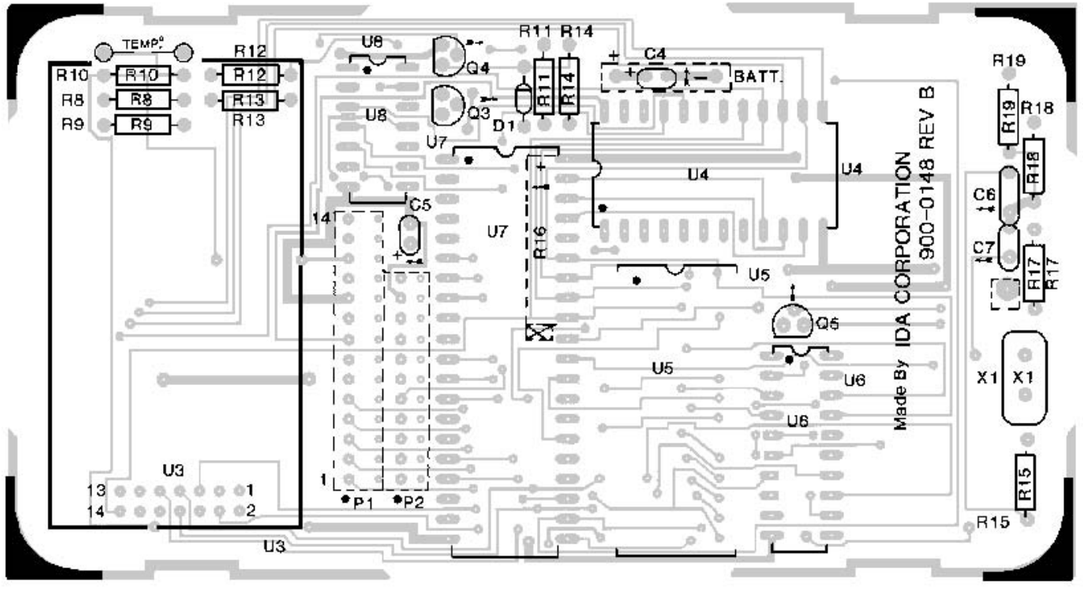
SOLDER SIDE



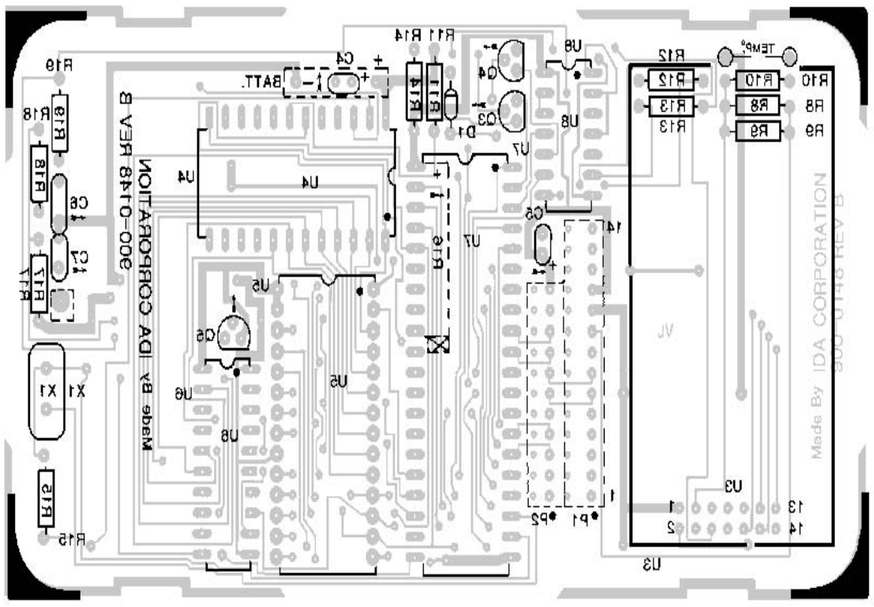
KEYPAD BOARD

(4130-S-01, Rev. B)

COMPONENT SIDE

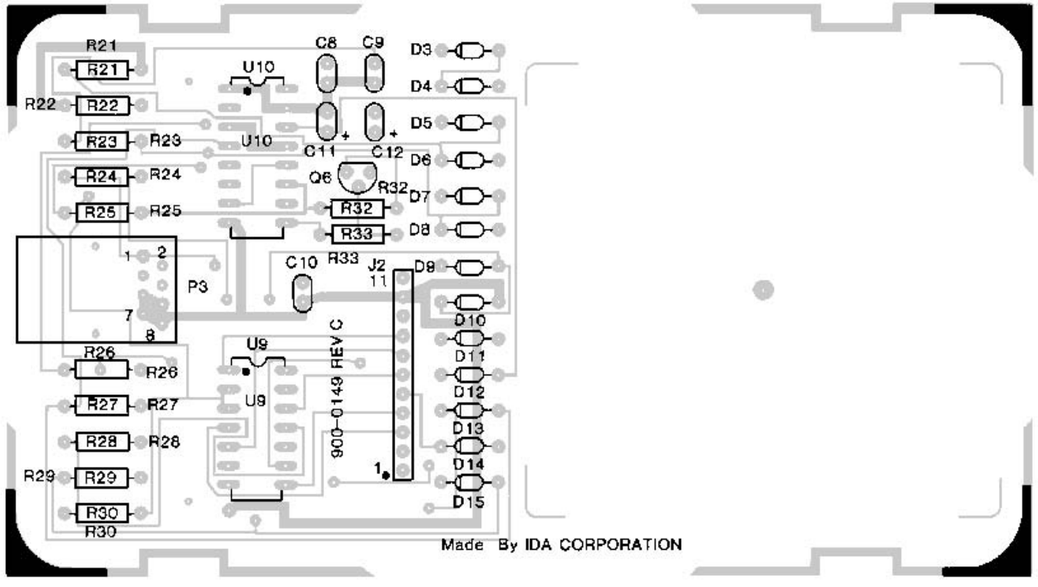


SOLDER SIDE

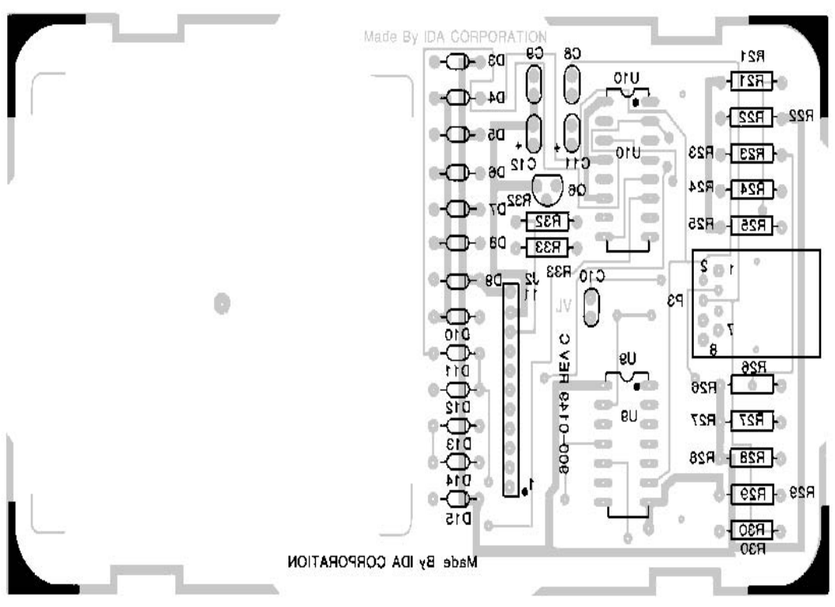


DISPLAY BOARD

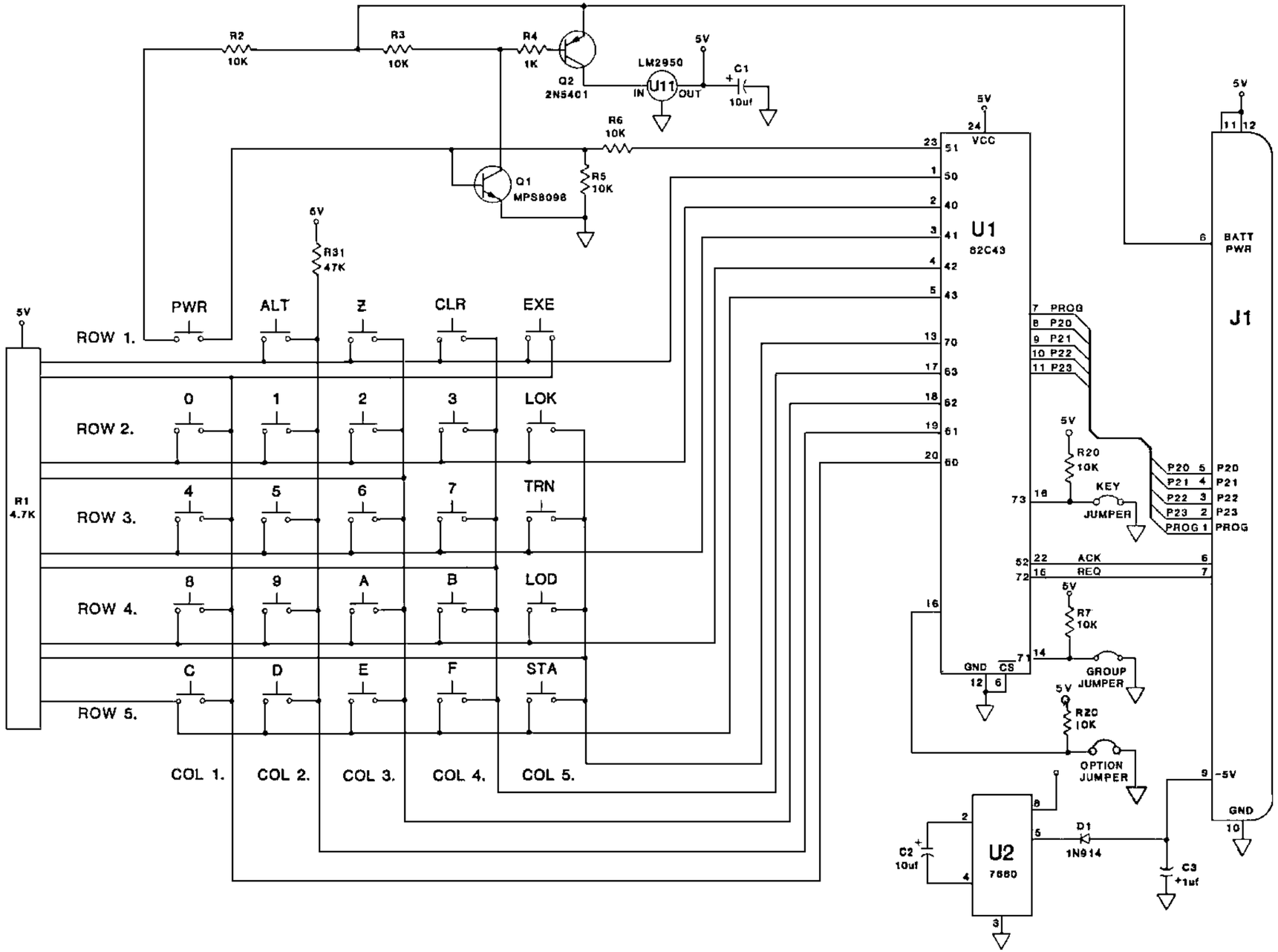
COMPONENT SIDE



SOLDER SIDE

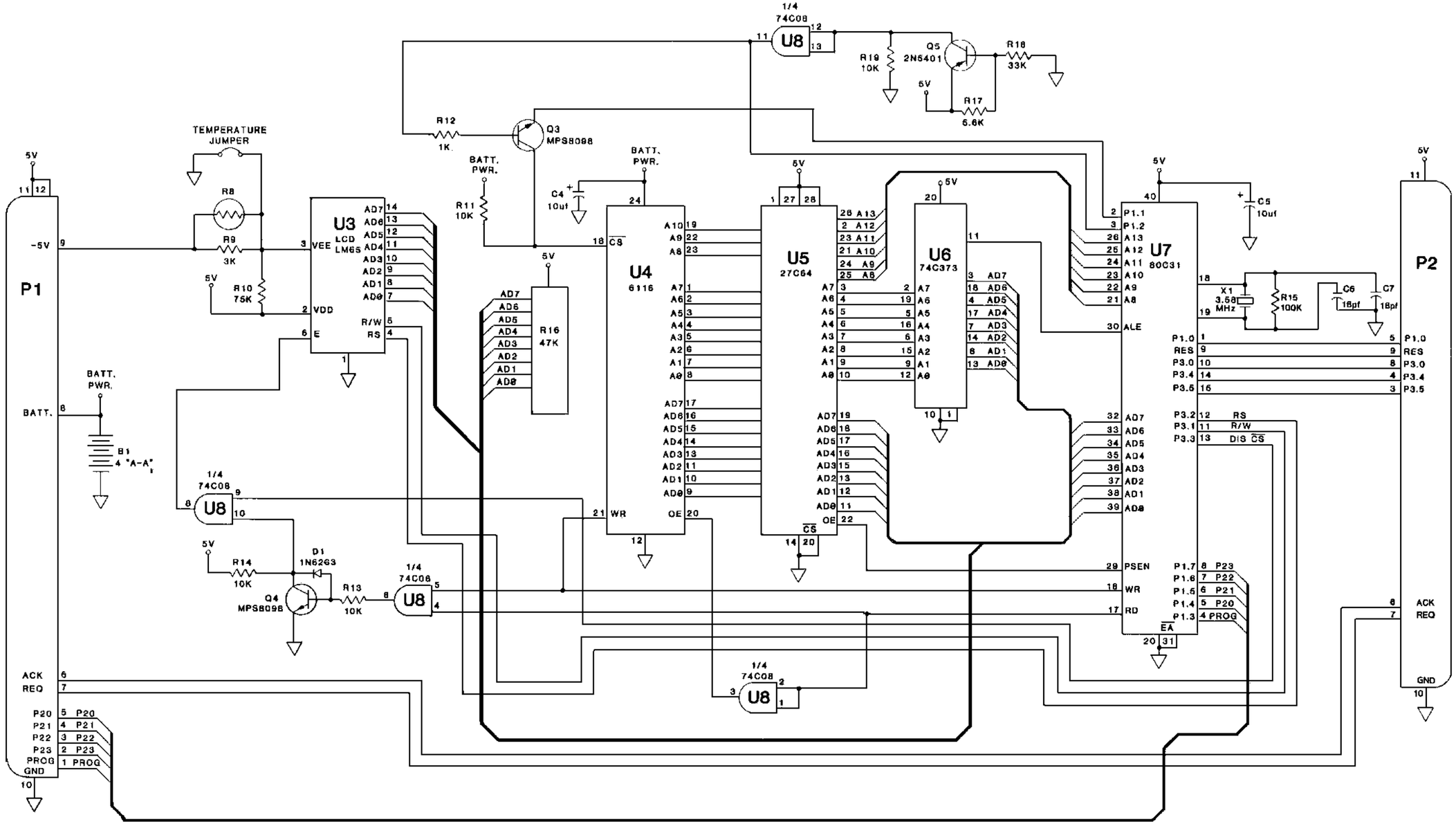


INTERFACE BOARD



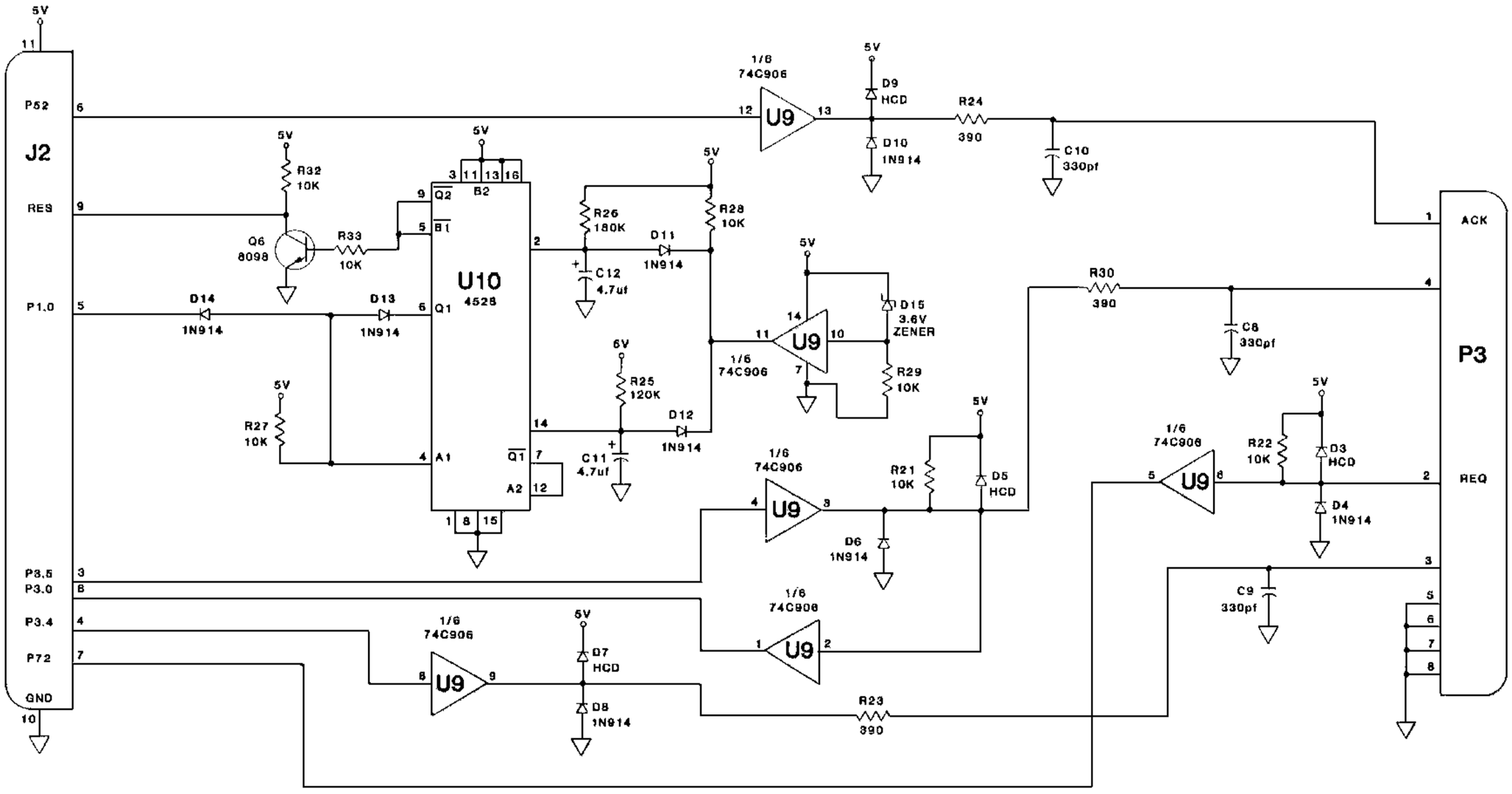
KEYPAD BOARD
J19/101-0147

(4130-S-00, Rev. B)



DISPLAY BOARD
J19/101-0148

(4131-S-00, Rev. B)



INTERFACE BOARD
J19/101-0149

(4132-S-00, Rev. B)

This page intentionally left blank